More Motion Questions — A Hodge-Podge

#1 (a) $\vec{v}_1 = 10\,m/s$ ↑ (+)
$\vec{a} = -3.0\,m/s^2$
$\vec{v}_2 = ?$
$\Delta t = 1.0\,s$
~~Δd~~

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$= 10 + (-3)(1)$
$= 7\,m/s.$

(b) (c) done in the same fashion

#2 $\vec{v}_1 = 30\,km/h$ [N 30°E]
$\Delta t = 10\,h$
$\Delta \vec{d} = ?$

$\Delta \vec{d} = 300\,km$ [N 30°E]

$\vec{v}_2 = 20\,km/h$ [W60°S]
$\Delta t = 17\,h$
$\Delta \vec{d} = ?$

$\Delta \vec{d} = \vec{v}\Delta t = 340\,km$ [W60°S]

Using vector components

HORIZ (+)→

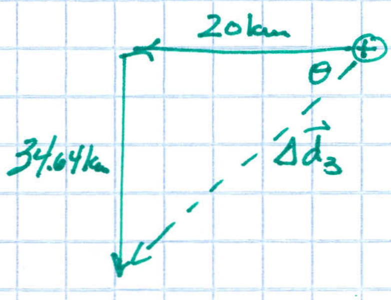
$\Delta \vec{d}_{1x} = 300 \sin 30\ km$
$\Delta \vec{d}_{2x} = -340 \cos 60\ km$

$\Delta d_{3x} = -20\,km$

VERT (+)↑

$\Delta \vec{d}_{1y} = 300 \cos 30\ km$
$\Delta \vec{d}_{2y} = -340 \sin 60\ km$

$\Delta \vec{d}_{3y} = -34.64\,km$



$|\Delta \vec{d}_3| = 40\,km$

$\theta = \tan^{-1}\left(\frac{34.64}{20}\right)$

$= 60°$

$\therefore \Delta \vec{d}_3 = 40\,km$ [W60°S]
[S30°W]

#3 $\vec{a} = 1.4 m/s^2$
$\vec{g} = 9.8 m/s^2$
$\theta = ?$

$\vec{a} = \vec{g} \sin\theta$
$1.4 = 9.8 \sin\theta$
$\sin\theta = 0.1429$

$\because \sin\theta = \frac{h}{L}$

$\therefore \frac{h}{L} = 0.1429$

$h = (0.1429) L$
$= (0.1429)(3.50)$
$= 0.50 m$

#4 $\vec{v}_1 = 40 km/h = 11.11 m/s$ (+ →)
$\vec{a} = -2.3 m/s^2$
$\Delta t = 2.70 s$
$\vec{v}_2 = ?$

FINAL SPEED

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$= 11.11 + (-2.3)(2.70)$
$= 4.8 m/s$

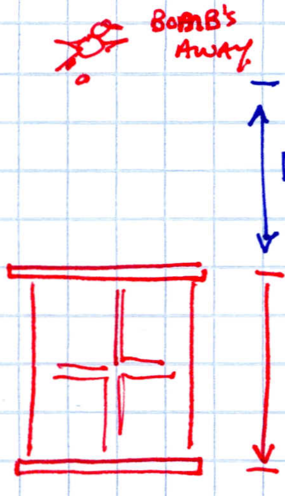
DISPLACEMENT

$\Delta\vec{d} = \vec{v}_1 \Delta t + \frac{1}{2}\vec{a}\Delta t^2$
$= (11.11)(2.70) - 1.15(2.70)^2$
$= 21.6 m$
$\doteq 22 m$

#5 $\vec{a} = 2.0 m/s^2$ (+ →)
$\Delta t = 2.30 s$
$\vec{v}_1 = 50 km/h = 13.89 m/s$
$\vec{v}_2 = ?$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$= 13.89 + (2)(2.30)$

#6



$v_1 = 0\,m/s$

$\vec{a} = 9.8\,m/s^2$

$h = ?\quad \Delta d = h = ?$

← TIME: NOT GIVEN

$\vec{v}_2$: NOT GIVEN → BUT IT WOULD BE THE SAME VALUE AS $\vec{v}_1$ IN THE WINDOW SECTION

THUS, FIND $\vec{v}_1$.

$\Delta t = 0.30\,s$

$\Delta \vec{d} = 2.40\,m$

$\vec{a} = 9.8\,m/s^2$

$\vec{v}_1 = ?$

(+ ↓)

$$\Delta \vec{d} = \vec{v}_1 \Delta t + \tfrac{1}{2}\vec{a}\Delta t^2$$

$$2.40 = 0.30 v_1 + \tfrac{1}{2}(9.8)(0.30)^2$$

$$2.40 = 0.30 v_1 + 0.441$$

$$1.959 = 0.30 v_1$$

$$v_1 = 6.53\,m/s$$

Thus, for the section above the window,

$$\vec{v}_2^{\,2} = \vec{v}_1^{\,2} + 2\vec{a}\Delta\vec{d}$$

$$6.53^2 = 0 + 2(9.8)\Delta\vec{d}$$

$$\Delta\vec{d} = 6.53^2/19.6$$

$$= 2.17\,m$$

#7 SUPERWOMAN (+) ↓

$\Delta t = 1.90\,s$

$\Delta \vec{v} = 140\,km/h = 38.89\,m/s$

PERSON FALLING UNIFORMLY.

(1)

By the time Superwoman realizes it, the person has fallen a distance of

$\Delta d = \vec{v} t$

$= 38.89(1.9)$

$= 73.89\,m$

(2)

How long does this person fall the rest of the way?

$\Delta \vec{d} = 1000 - 73.89$

$= 926.11\,m$

$\vec{v} = 38.89\,m/s$

$\Delta t = ?$

$\Delta t = \frac{\Delta \vec{d}}{v}$

$= 23.81\,s$

Thus Superwoman has 23.81 s in which to accelerate the 1000 m distance.

(3)

$\Delta \vec{d} = 1000\,m$

$\vec{a} = ?$

$\Delta t = 23.81\,s$

$\vec{v}_1 = 0\,m/s$

$\Delta \vec{d} = \vec{v}_1 \Delta t + \frac{1}{2} \vec{a} \Delta t^2$

$1000 = \frac{1}{2}(\vec{a})(23.81)^2$

$\vec{a} = 3.53\,m/s^2$